

REMARKS

Favorable reconsideration of this application, in light of the following discussion, is respectfully requested.

Claims 13 and 18 are cancelled. Claims 1, 10 and 17 are amended. Claims 1-12, 14-17, 19 and 20 are pending.

I. Rejection under 35 U.S.C. § 102

In the Office Action, at page 2, numbered paragraph 2, claims 1 and 10 were rejected under 35 U.S.C. § 102(b) as being unpatentable over U.S. Patent No. 4,402,053 to Kelley et al. This rejection is respectfully traversed because Kelley does not discuss or suggest:

a hand attached to a distal end of the robot arm and having holding means for holding an object;

detecting means for detecting an object to be taken out; and

a controller for issuing commands to said hand,

wherein said hand has orientation changing means for changing orientation of said holding means to selectively take one of a plurality of orientations including a first orientation and a second orientation different from each other with respect to said robot arm in accordance with a command from said controller, said controller issuing the command to said hand prior to holding of the object in accordance with a status of the object to be taken out detected by said detecting means, thereby selectively changing the orientation of said holding means prior to the holding of the object,

as recited in amended independent claim 1.

Further, Kelley does not discuss or suggest:

a hand attached to a distal end of the robot arm and having holding means for holding an object, a center of holding by said holding means being offset from a center axis of a proximal portion thereof;

orientation changing means provided at said hand, for changing orientation of said holding means to selectively take one of a plurality of orientations including a first orientation and a second orientation different from each another; and

a visual sensor for detecting a condition of placement of an object, wherein said orientation changing means changes the orientation of said holding means according to the detected condition before holding the object,

as recited in amended independent claim 10.

As a non-limiting example, the present invention of claim 1, for example, is directed to an object taking-out apparatus for taking out an object including a robot having a robot arm, a hand attached to the distal end of the robot arm, detecting means for detecting an object to be taken out, and a controller for issuing commands to the hand. The hand has an holding means for holding an object and an orientation changing means for changing the orientation of the holding means to selectively take one of a plurality of orientations including a first orientation and a second orientation different from each other with respect to the robot arm in accordance with a command from the controller. The controller issues the command to the hand prior to holding of the object in accordance with a status of the object to be taken out detected by the detecting means, thereby selectively changing the orientation of the holding means prior to the holding of the object.

Kelley discusses a robot assembly for acquiring unoriented workpieces from a bin. A sensing system views the bin and collects data, and a computer analyzes the data to determine candidate holdsites on the workpiece. Then the hand engages the workpiece at a selected holdsite and the workpiece is moved to a pose where the position and orientation of the workpiece are determined. Kelley further discusses that the robot assembly 20 includes an arm 22 and hand 26 to which a vacuum cup 28 is affixed. The vacuum cup 28 acquires randomly-orientated workpieces, and the arm 22 and wrist 24 are moved so that the arm 22 is held in a presentation pose. Then an image is formed using the workstation camera 44 and image features of the workpiece are extracted. The robot assembly 20 moves to the second presentation pose, a second image is formed and image features are extracted. The images are compared and matched to a workpiece model to determine the six dimensional position and orientation of the workpiece.

While Kelley does discuss the use of a vacuum cup 28 that is attached to an end of the arm 24 of the robot assembly to hold an object, Kelley does not discuss or suggest that an orientation changing means is provided at the hand 26. Kelley discusses that the vacuum cup 28 is attached to the hand 26 (16 in Fig. 2) and is capable of picking up an object, but Kelley does not suggest that an orientation changing means is provided at the hand 26, specifically for changing the orientation of the holding means, where the holding means is alleged to correspond with the vacuum cup 28. Further, Kelley does not discuss or suggest that the robot assembly includes a controller which issues a command to the hand prior to holding an object in accordance with a status of the object to be taken out, which is detected by a detecting means, to selectively change the orientation of the vacuum cup 28 prior to the holding of the object.

In contrast, the present invention of claim 1, for example, requires the use of an orientation changing means, which changes the orientation of the holding means 35 to take one of a plurality of orientations, including a first and second orientation different from each other with respect to the robot arm, and requires that a controller issues a command to the hand prior to holding an object in accordance with a status of the object to be taken that is detected by a detecting means out to change the orientation of the holding means prior to the holding of the object. Thus, as the detecting means detects an object to be taken out and the controller issues a command to the hand prior to holding the object, the command being issued in accordance with a status of the object, to change the orientation of the holding means, the orientation of the holding means 35 attached to the distal end of the robot arm 10 is able to be changed in accordance with the position and orientation of an object to be removed from a container 11, the presence of the object overlapping another object, the positional relation with respect to the container wall 12, etc. The present invention of claim 1, for example, allows for the holding means 35 to take an orientation in accordance with the position and orientation of the object, based on the detecting of the object by the detecting means.

While Kelley does include a camera 42 used to select holdsights on workpieces 80 in a bin 82, Kelley does not discuss or suggest that the camera 42 detects a status of a workpiece 80 and that a controller issues a command to the hand 26 prior to holding of the workpiece 80 in accordance with the status of the workpiece 80, the command selectively changing the orientation of the vacuum cup 28 prior to holding of the workpiece 80. Kelley does not suggest that the wrist 24 changes the orientation of the vacuum cup 28 to take one of multiple orientations in accordance with a command from a controller, where the controller issues the command prior to holding of a workpiece in accordance with a status of the workpiece detected by a detecting means, for example, camera 42.

In contrast, the present invention of claim 1, for example, discusses that rotary supports 33, 34, coupling member 31 and telescoping means 32 are able to manipulate the holding means 35 to change the orientation of the holding means 35 to take one of multiple orientations in accordance with a command from a controller, where the controller issues the command prior to holding of an object in accordance with a status of the object that is detected by, for example, sensor and image capturing means 4.

Further, in contrast to the hand 26 and vacuum cup 28 of Kelley, the holding means 35 of the present invention of claim 1, for example, is attached to the distal end of the arm 10 and the orientation means (elements 31-34) is able to change the orientation of the holding means 35,

which is distinct from changing the orientation of the arm 10. Kelley discusses changing the orientation of the arm, but does not suggest changing the orientation of the holding means, which the Examiner alleges corresponds to the vacuum cup 28.

With respect to claim 10, Kelley does not discuss or suggest that, for a hand attached to a distal end of a robot arm and having holding means for holding an object, a center of holding by the holding means is offset from a center axis of a proximal portion of the hand. In the present invention of claim 10, for example, the center of holding is offset from a center axis of a proximal portion of the holding means (hand body) attached to the distal end of the robot arm. Thus, as the center of the holding means 35 is offset from the center axis of the proximal portion of the hand body, it is not necessary, for the present invention of claim 10, to align a center axis of the object to be removed with the center axis of the proximal portion of the hand. Therefore, the center of the proximal portion of the hand can take a position or posture which is offset to an inner side of the container 11 in order to avoid interference between the hand and the inner wall 12 of the container 11.

Kelley discusses that Fig. 3 shows the relationship between a base coordinate system of the robot assembly and the hand coordinate system in terms of the arm joint coordinate system. The offset discussed in Kelley is an offset of the axis 06 of the wrist 24 in the direction of "h". Kelley does not discuss or suggest that the center of holding of the holding means, in this case, vacuum cup 28, is offset from a center axis of a proximal portion of the hand 26 (16 in Fig. 2). Kelley clearly shows that vacuum cup 28 is directly beneath hand 26, not offset from a center axis of a proximal portion of the hand 26. Fig. 3 does not show that the holding means is offset with respect to the hand, but merely shows the relationship between the robot assembly and the hand.

Also, as discussed above with respect to claim 1, claim 10 does not discuss or suggest the use of a sensor that detects a condition of placement of an object, where orientation changing means changes the orientation of holding means according to the detected condition before holding the object.

Therefore, as Kelley does not discuss or suggest "detecting means for detecting an object to be taken out;... wherein said hand has orientation changing means for changing orientation of said holding means to selectively take one of a plurality of orientations including a first orientation and a second orientation different from each other with respect to said robot arm in accordance with a command from said controller, said controller issuing the command to said hand prior to holding of the object in accordance with a status of the object to be taken out

detected by said detecting means, thereby selectively changing the orientation of said holding means prior to the holding of the object," as recited in amended independent claim 1, and does not discuss or suggest "a hand attached to a distal end of the robot arm and having holding means for holding an object, a center of holding by said holding means being offset from a center axis of a proximal portion thereof; orientation changing means provided at said hand, for changing orientation of said holding means to selectively take one of a plurality of orientations including a first orientation and a second orientation different from each another; and a visual sensor for detecting a condition of placement of an object, wherein said orientation changing means changes the orientation of said holding means according to the detected condition before holding the object," as recited in amended independent claim 10, claims 1 and 10 patentably distinguish over the reference relied upon. Accordingly, withdrawal of the § 102(b) rejection is respectfully requested.

II. Rejections under 35 U.S.C. § 103

In the Office Action, at pages 3-5, numbered paragraphs 4-6, claims 2-9, 11-20 were rejected under 35 U.S.C. § 103(a) as being unpatentable over various combinations of Kelley in view of U.S. Patent No. 6,597,971 to Kanno and U.S. Patent No. 4,613,269 to Wilder et al. Claims 13 and 18 have been cancelled. These rejections are respectfully traversed.

As discussed above with respect to claims 1 and 10, Kelley does not discuss or suggest all the features of claims 1 and 10. Kanno and Wilder fail to make up for the deficiencies in Kelley, specifically as to a controller issuing a command to a hand prior to holding of an object in accordance with a status of the object to be taken out detected by detecting means, thereby selectively changing the orientation of holding means prior to the holding of the object. Accordingly, claims 1 and 10 patentably distinguish over the references relied upon. Claims 2-9, 11, 12 and 14-16 depend either directly or indirectly from independent claims 1 and 10 and include all the features of their respective independent claims, plus additional features that are not discussed or suggested by the reference relied upon. For example, claim 2 recites that "the first orientation is set such that a direction of a holding axis of said holding means is closest to a direction of a rotational axis of the distal end of the robot arm in the plurality of orientations to form a predetermined angle not equal to zero degree between the direction of the holding axis and the direction of the rotational axis of the distal end of the robot arm." Therefore, claims 2-9, 11, 12 and 14-16 patentably distinguish over the references relied upon for at least the reasons discussed above.

As to claim 17, in an argument similar to that which was described above, Kelley does not discuss or suggest:

a visual sensor for detecting condition of overlapping of objects,
wherein a holding position of the object by said holding means is
changed according to the detected condition, and
wherein a center of holding by said holding means is offset from a
center axis of a proximal portion thereof and a predetermined
angle not equal to zero degree is formed between a direction of a
holding axis of said holding means and a rotational axis of the
distal end of the robot arm,

as recited in amended independent claim 17. Kelley does not discuss or suggest that the camera 42 is used for detecting a condition of overlapping of objects and that a holding position of the object by a holding means is changed according to the detected condition. Further, as discussed above, Kelley does not discuss that a center of holding by a holding means is offset from a center axis of a proximal portion thereof and a predetermined angle not equal to zero degree is formed between a direction of a holding axis of the holding means and a rotational axis of the distal end of the robot arm.

Therefore, claim 17 patentably distinguishes over the reference relied upon. Accordingly, withdrawal of the § 103(b) rejection is respectfully requested.

Claims 19 and 20 depend either directly or indirectly from independent claim 17 and include all the features of claim 17, plus additional features that are not discussed or suggested by the reference relied upon. For example, claim 19 recites that "said visual sensor has image capturing means attached to the distal end of the robot arm through a slider mechanism movable in directions away from and toward the distal end of the robot arm, and said image capturing means is moved in the direction away from the distal end of the robot arm when capturing an image, and moved in the direction toward the distal end of the robot arm when said holding means holds the object." Therefore, claims 19 and 20 patentably distinguish over the reference relied upon for at least the reasons noted above. Accordingly, withdrawal of the § 103(b) rejection is respectfully requested.

III. 35 U.S.C. § 112, 6th paragraph

The Applicants respectfully submit that there is no requirement, in accordance with either 35 U.S.C. § 112, 6th paragraph or 37 C.F.R. Chapter I, that the Applicants are required to invoke or not invoke 35 U.S.C. § 112, 6th paragraph. It is requested that the Examiner's requirement in item 7 should be withdrawn.

Conclusion

In accordance with the foregoing, claims 13 and 18 have been cancelled. Claims 1, 10 and 17 have been amended. Claims 1-12, 14-17, 19 and 20 are pending and under consideration.

There being no further outstanding objections or rejections, it is submitted that the application is in condition for allowance. An early action to that effect is courteously solicited.

Finally, if there are any formal matters remaining after this response, the Examiner is requested to telephone the undersigned to attend to these matters.

If there are any additional fees associated with filing of this Amendment, please charge the same to our Deposit Account No. 19-3935.

Respectfully submitted,

STAAS & HALSEY LLP

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5/21/07

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